REMARKS

Applicants appreciate the thoroughness with which the Examiner has examined the above-identified application. Reconsideration is requested in view of the amendments above and the remarks below.

In the foregoing amendment, no claims have been amended or canceled, and no new matter has been added, thereby reducing the number of issues on appeal.

35 USC Claim Rejections

Claims 10, 12-27 and 29-30 have been rejected under 35 USC 103(a) as being unpatentable over U.S. Patent No. 5,478,780 to Koerner et al. in view of U.S. Patent No. 5,043,299 to Chang et al. Applicants disagree.

As recited above in pending claims 10 and 12-30, the instant invention is directed to an apparatus for selectively forming a metal silicide over a semiconductor substrate. The apparatus includes a chamber and a heating element for forming the metal silicide. The chamber 50 has at least one workpiece holder to hold a substrate, having silicon and insulator portions on a surface thereof, with an oxide layer thereover.

Chamber 50 also has at least one line 52, i.e., a first line, operatively connected between the chamber and a pump for evacuating and maintaining the entire chamber at a continuous vacuum, particularly, prior to and during cleaning of

the substrate surface. The chamber 50 also has at least one input line 22, i.e., a second line, for introducing a cleaning agent into the chamber for the purpose of removing any oxide on the surface of the substrate while in the continuous vacuum, and at least one output line 24, i.e., a third line, to remove the cleaning agent and the removed oxide from the chamber. The chamber 50 also has a reactor within the chamber 50 for depositing a metal onto the cleaned silicon and insulator portions of the substrate surface while within the continuous vacuum.

The heating element of the instant apparatus heats the substrate, having the metal deposited thereover, to form silicide only over the silicon portions of the substrate surface. An etchant then removes unreacted metal from over the insulator portions, thus selectively forming metal silicide on portions of the substrate.

As recited in dependent claims 12, 14, 22 and 23, the chamber 50 may have at least one interior chamber 10 for cleaning the substrate surface by removing oxide therefrom while under the continuous vacuum, and at least one interior chamber 30 for depositing the metal, whereby the wafer is transferred from the cleaning chamber 10 to the deposition chamber 30 within chamber 50 under continuous vacuum without breaking such vacuum. That is, within main chamber 50 are cleaning chamber 10 and deposition chamber 30 whereby the continuous vacuum of the system is maintained throughout chamber 50.

Koerner et al. is directed a high-vacuum system comprising of at least two high-vacuum chambers of chambers 1-6, at least one high-vacuum distributor

chamber 7 and at least two high-vacuum supply chambers 8, 9. (Fig. 1, col. 4, lines 42-47.) As disclosed and shown, the central distributor chamber 7 is insulated from and independent of chambers 1-6 and the supply chambers 8, 9, i.e., it is merely connected to the chambers 1-6, 8 and 9. (Fig. 1 and col. 4, lines 47-51.) Koerner et al. further discloses the uniform formation of silicides across the surface of the substrate by providing a substrate in a chamber 1 which has only an input line of Ar gas. That is, it is submitted that this chamber 1 does not have an output line for removing the cleaning agent and the removed oxide. As a result, any removed oxide remains within chamber 1 and therefore may be redeposited thereon the substrate surface.

Applicants submit that Chang et al. is discloses a cleaning chamber 10 having a pedestal 16 on which a wafer 100 is placed, a showerhead 20 attached to a pipe 22 from a gas source and a gas evacuation port 24 through which gas is evacuated from chamber 10 through pipe 26 to a vacuum pump 90. (Fig. 2 and col. 2, line 62 to col. 3, line 40.) The cleaning chamber 10 is connected to a CVD chamber 40 via an air-tight passageway 70. (Fig. 2, col. 2, lines 64-67.) Passageway 70 has a first slit valve 82 that wafer 100 is admitted through to enter the passageway and a second slit valve 84 that the wafer passes through to exit passageway 70 and enter CVD chamber 40. (Fig. 2 and col. 3, line 58-63.) This passageway 70 has a vacuum pump 90 via pipe 78 for maintaining a pressure in the passageway and an entrance port 74 through which one or more non-oxidizing gases may be flowed into

passageway 70 via pipe 76. (Fig. 2 and col. 4, line 1-15.) In accordance with Chang et al. a wafer 100 is cleaned in chamber 10, passes through passageway 70 and then into CVD chamber 40 having a heater 45 to heat the wafer during deposition of tungsten using a mixture of a tungsten-containing gas and a reducing gas flown into chamber 40 via pipe, showerhead 52, 50. (Fig. 2 and col. 5, line 21-30.) An exit port 54 connected to vacuum pump 90 maintains a pressure in CVD chamber 40. (Fig. 2 and col. 5, line 18-20.)

The Examiner has rejected all of applicants' pending claims, stating that Koerner et al. disclose an apparatus for forming a silicide on a surface of a silicon (column 4, row 59) semiconductor substrate, comprising: a plurality of interior chambers (Fig. 1, 1-6; abstract) in which multiple method stages (including removing an oxide using a cleaning agent, depositing a metal layer, etching and heating) can be carried out at high vacuum without interruption (column 5, rows 1-10). The apparatus is adapted to heat a substrate to form a silicide on a surface of the substrate (column 3, rows 35-39). The Examiner recognizes that the Koerner et al. patent fails to disclose specific structural details as recited by applicants, as well as fails to disclose the use of nitrogen triflouride as a cleaning gas to remove silicon oxides.

However, the Examiner contends that applicants' invention would have been obvious to one of ordinary skill in the art at the time the invention was made in view of equipping the chamber as disclosed by Koerner et al. with apparatus known to be

needed to process a wafer without exposing a cleaned wafer to contamination prior to deposition as disclosed by Chang et al.

Applicants continue to disagree and submit that the instant invention would not be obvious over Koerner et al. in view of Chang et al.

It is respectfully submitted, and the Examiner concurred, that Koerner et al. fails to disclose specific structural details as recited by applicants. In particular, it is submitted that Koerner et al. fails to disclose an apparatus for selectively forming a metal silicide on a substrate including a heating element and a chamber, i.e., a single, main chamber 50, that has at least a first line connected to a pump to evacuate and maintain the chamber at a continuous vacuum, a second line for introducing a cleaning agent into the chamber, a third line for removing the cleaning agent and removed oxide, and a reactor –all within this chamber under a continuous vacuum, as recited in the instant claims. Koerner et al. discloses a plurality of high-vacuum process chambers connected to a central processing chamber 7. (Fig. 1, abstract, col. 4, lines 43-59.) Further, Koerner et al. fails to disclose an apparatus, as is instantly claimed in claims 12, 14, 22 and 23, whereby the chamber, i.e., mainframe chamber 50, has therein a cleaning chamber 10 and a deposition chamber 30 whereby the continuous vacuum of the system 50, 10, 30 is maintained throughout. Koerner et al. specifically discloses a central distributor chamber 7 that is insulated from and independent of chambers 1-6, 8 and 9. (Fig. 1 and col. 4, lines 47-51.) Accordingly, it is respectfully submitted that the instant invention is

structurally different from the system as disclosed in Koerner et al., such that, Koerner et al. would not render obvious the instant invention.

Applicants submit that the Chang et al. reference does not remedy the deficiencies of Koerner et al. As discussed above, Chang et al. discloses two separate, distinct processing chambers, i.e., cleaning chamber 10 and CVD chamber 40, that are connected to each other by an air-tight passageway 70. (Fig. 2, col. 2, lines 64-67.) This passageway 70 has slit valves 82, 84 that a wafer must pass through to enter the passageway 70 from cleaning chamber 10 and from passageway 70 to CVD chamber 40. (Fig. 2 and col. 3, line 58-63.) Thus, like Koerner et al., Chang discloses a plurality of chambers connected to each other, not a single main chamber or a main chamber containing within processing chambers all under a continuous vacuum. The instantly claimed apparatus is structurally different from the system disclosed in Chang et al., such that, Chang et al. would not render obvious the instant invention, nor would it remedy the deficiencies of Koerner et al.

As both Koerner et al. and Chang et al. are directed to systems that having separate, independent processing chambers that are connected by a central distribution chamber 7 or a passageway 70, respectively, it is submitted that neither Koerner et al. nor Chang et al., alone or in combination, disclose or suggest an apparatus as is instantly claimed. In particularly, neither Koerner et al. nor Chang et al., alone or in combination, disclose or suggest an apparatus including a heating element and a chamber, whereby the chamber has a first line for evacuating and

maintaining a constant vacuum therein, a second line for introducing a cleaning agent into the mainframe chamber and a third line for removing the cleaning agent and any removed oxide from a substrate surface, thereby providing such substrate with a substantially oxide-free surface. As such, neither reference, alone nor in combination, discloses that a chamber under constant vacuum may have therein a cleaning chamber and a deposition chamber for selective formation of a metal silicide on a substrate surface. For these reasons, applicants respectfully submit that neither Koerner et al. nor Chang et al., alone or in combination, render obvious the instant invention as such references do not teach all the structural limitations as instantly claimed. *See,* Ex parte Masham, 2 U.S. Patent No. Q 2d 1647 (Bd. Pat. App. & Inter. 1987).

The Examiner has also rejected claim 28, as applied to claims 10, 12-27 and 29 above, and further in view of the Japanese Patent Publication No. 63-000480 A to Takebayashi et al. Takebayashi et al. is merely cited for the limitation of a heating element external to the chamber. It does not disclose or even suggest an apparatus, as is currently claimed, for selective formation of a silicide on a substrate surface whereby the apparatus comprises a heating element and a chamber having a first line connected to a pump to evacuate and maintain the chamber at a continuous vacuum, a second line for introducing a cleaning agent into the chamber, a third line for removing the cleaning agent and removed oxide, and a reactor –all within the chamber. Accordingly, applicants submit that the Takebayashi et al. Japanese patent

does not overcome the deficiencies of the Koerner et al or the Chang et al. references, alone or in any proper combination thereof.

Applicants submit that the instant invention is structurally different from the systems disclosed in Koerner et al., Chang et al., and Takebayashi et al., alone or in combination, such that, the above cited references, alone or in any combination, do not render obvious pending claims 10 and 12-30.

It is respectfully submitted that the application has now been brought into a condition where allowance of the case is proper. Reconsideration and issuance of a Notice of Allowance are respectfully solicited. Should the Examiner not find the claims to be allowable, Applicants' attorney respectfully requests that the Examiner call the undersigned to clarify any issue and/or to place the case in condition for allowance.

Respectfully submitted,

Kelly M. Reynolds
Reg. No. 47,898

DeLIO & PETERSON, LLC
121 Whitney Avenue
New Haven, CT 06510-1241
(203) 787-0595

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